

Application No. 09/784761 (Docket: BAN.0103)
37 CFR 1.111 Amendment dated 07/12/2006
Reply to Office Action of 02/14/2006

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AMENDMENTS TO THE CLAIMS

Please cancel claims 6, 13, 20, 28, and 34 without prejudice. Kindly amend claims 1, 5, 7-9, 11, 14-17, 19, 21, 23-24, 27, 29-30, 33, 35, and 40 as shown in the following listing of claims. The listing of claims will replace all prior versions, and listings, of claims in the application:

Listing of Claims

1. (Currently Amended) A TCP-aware target adapter, for accelerating TCP/IP connections between a plurality of clients and a plurality of servers, the plurality of servers being accessed via an Infiniband fabric, the plurality of clients being accessed via a TCP/IP network, the TCP-aware target adapter comprising:

an accelerated connection processor, configured to bridge TCP/IP transactions between the plurality of clients and the plurality of servers, wherein said accelerated connection processor accelerates the TCP/IP connections by ~~intercepting commands provided to the servers' TCP/IP stacks and~~ prescribing Infiniband remote direct memory access operations to retrieve/provide transaction data from/to the plurality of servers, wherein said accelerated connection processor comprises:

a connection correlator, configured to associate TCP/IP connection parameters with a target work queue number for each of a plurality of accelerated TCP/IP connections; and

a target channel adapter, coupled to said accelerated connection processor, configured to support Infiniband operations with the plurality of servers, and configured to execute said Infiniband remote direct memory access operations to retrieve/provide said transaction data;

whereby the TCP/IP connections are accelerated by offloading TCP/IP processing otherwise performed by the plurality of servers to retrieve/provide said transaction data.

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2. (Original) The TCP-aware target adapter as recited in claim 1, wherein said accelerated connection processor comprises:

a plurality of native network ports, each of said native network ports
communicating with the plurality of clients in a native network protocol
corresponding to the plurality of clients.
3. (Original) The TCP-aware target adapter as recited in claim 2, wherein said native network protocol comprises one of the following protocols: Ethernet, Wireless Ethernet, Fiber Distributed Data Interconnect (FDDI), Attached Resource Computer Network (ARCNET), Synchronous Optical Network (SONET), Asynchronous Transfer Mode (ATM), and Token Ring.
4. (Original) The TCP-aware target adapter as recited in claim 2, wherein said accelerated connection processor supports TCP/IP transactions with the plurality of clients by receiving/transmitting native transactions in accordance with said native network protocol.
5. (Currently Amended) The TCP-aware target adapter as recited in claim 4, ~~wherein~~ each- wherein said each of a plurality of accelerated TCP/IP connections comprises:

a plurality of said Infiniband remote direct memory access operations between a particular server and said target channel adapter to retrieve/provide particular transaction data from/to said particular server; and

corresponding native transactions between said accelerated connection processor and a particular client to provide/retrieve said particular transaction data to/from said particular client.
6. (Cancelled)
7. (Currently Amended) The TCP-aware target adapter as recited ~~in claim 6~~ in claim 1, wherein said TCP/IP connection parameters comprise: source TCP port number, destination TCP port number, source IP address, and destination IP address.

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8. (Currently Amended) The TCP-aware target adapter as recited in ~~claim 6~~ claim 1, wherein said target work queue number corresponds to a host work queue number within a specific server, said specific server being designated by said accelerated connection processor to support said each of a plurality of accelerated TCP/IP connections with a specific client.
9. (Currently Amended) An apparatus in a server connected to an Infiniband fabric for implementing accelerated TCP/IP connections between the server and clients, the clients being connected to a TCP/IP network, the apparatus comprising:
- a connection acceleration driver, configured to manage the accelerated TCP/IP connections, ~~wherein said accelerated TCP/IP connections are established via intercepting commands provided to the server's TCP/IP stack, and~~ wherein said connection acceleration driver designates memory locations within server memory such that transaction data can be retrieved/provided via Infiniband remote direct memory access operations, wherein said connection acceleration driver comprises:
 - correlation logic, configured to associate TCP/IP connection parameters with a host work queue number for each of the accelerated TCP/IP connections; and
 - a host channel adapter, coupled to said connection acceleration driver, configured to execute Infiniband operations via the Infiniband fabric, and configured to execute direct memory access functions to retrieve/provide said transaction data responsive to said Infiniband remote direct memory access operations;
- whereby the accelerated TCP/IP connections offload TCP/IP processing otherwise performed by the server to retrieve/provide said transaction data.

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10. (Original) The apparatus as recited in claim 9, wherein a particular accelerated TCP/IP connection comprises:

a plurality of said remote direct memory access operations between the server and
a TCP-aware target adapter to retrieve/provide particular transaction data
from/to a particular memory location; and

corresponding native transactions between said TCP-aware target adapter and a
particular client to provide/retrieve said particular transaction data to/from
said particular client.
11. (Currently Amended) The apparatus as recited in claim 9, wherein said connection acceleration driver ~~comprises~~further comprises:

native queue logic, configured to interpret a native network protocol
corresponding to the clients, and configured to request/receive first
Infiniband operations having native TCP/IP transactions to/from the
clients that are embedded within Infiniband packets;

accelerated queue logic, configured to request second Infiniband operations to
establish the accelerated TCP/IP connections, said second Infiniband
operations designating said memory locations; and

a transport driver interface mux, coupled to said accelerated queue logic,
configured to receive said memory locations from application programs,
and configured to provide said memory locations to said accelerated queue
logic.
12. (Original) The apparatus as recited in claim 11, wherein said transport driver interface mux is coupled via a transport driver interface to a TCP/IP stack within the server.
13. (Cancelled)
14. (Currently Amended) The apparatus as recited ~~in claim 13~~ in claim 11, wherein said TCP/IP connection parameters comprise: source TCP port number, destination TCP port number, source IP address, and destination IP address.

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15. (Currently Amended) The apparatus as recited in ~~claim 13~~ in claim 11, wherein said host work queue number corresponds to a target work queue number within a TCP-aware target adapter, said TCP-aware target adapter providing corresponding native transactions to the clients for said each of the accelerated TCP/IP connections.

16. (Currently Amended) An apparatus within a client-server environment for managing an accelerated TCP/IP connection between a server connected to an Infiniband fabric and a client connected to a TCP/IP network, the apparatus comprising:

a host driver, for providing a host work ~~queue~~ queue pair through which transaction data corresponding to the accelerated TCP/IP connection is transmitted/received via the Infiniband fabric, ~~wherein said host driver intercepts a command provided to the server's TCP/IP stack to accelerate the accelerated TCP/IP connection;~~ and

a TCP-aware target adapter, coupled to said host driver, for providing a target work ~~queue~~ queue pair corresponding to said host work ~~queue~~ queue pair, and for executing a remote direct memory access operation to receive/transmit said transaction data via the Infiniband fabric, wherein said TCP-aware target adapter comprises:

a connection correlator, for associating TCP/IP connection parameters for the accelerated connection with a target work queue number corresponding to said target work queue pair;

whereby the accelerated TCP/IP connection offloads TCP/IP processing otherwise performed by the server to receive/transmit said transaction data.

17. (Currently Amended) The apparatus as recited in claim 16, wherein said TCP-aware target adapter ~~comprises~~ further comprises:

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- a plurality of native network ports, each of said native network ports
communicating with TCP/IP clients via a corresponding native network
protocol.
18. (Original) The apparatus as recited in claim 17, wherein said corresponding native network protocol comprises one of the following protocols: Ethernet, Wireless Ethernet, Fiber Distributed Data Interconnect (FDDI), Attached Resource Computer Network (ARCNET), Synchronous Optical Network (SONET), Asynchronous Transfer Mode (ATM), and Token Ring.
19. (Original) The apparatus as recited in claim 17, wherein said TCP-aware target adapter further comprises:
an accelerated connection processor, for supporting TCP/IP transactions with ~~the clients~~the client by receiving/transmitting native transactions in accordance with said corresponding native network protocol.
20. (Cancelled)
21. (Currently Amended) The apparatus as recited ~~in claim 20~~in claim 19, wherein said host driver comprises:
connection correlation logic, for associating said TCP/IP connection parameters for the accelerated connection with a host work queue number that corresponds to said host work queue pair.
22. (Original) The apparatus as recited in claim 21, wherein said TCP/IP connection parameters comprise: source TCP port number, destination TCP port number, source IP address, and destination IP address.
23. (Currently Amended) A method for accelerating TCP/IP connections in a client-server environment having clients that are connected to a TCP/IP network and servers that are connected to an Infiniband fabric, the method comprising:
~~first intercepting requests to send/receive data provided to the servers' TCP/IP stacks;~~

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mapping TCP/IP connection parameters for accelerated connections to
corresponding host and target work queue numbers that correspond to host
and target work queue pairs; and

offloading TCP/IP processing otherwise performed by the servers by executing
Infiniband remote direct memory access operations to retrieve/transmit
data associated with the accelerated connections from/to memory within
the servers.

24. (Currently Amended) The method as recited in claim 23, wherein said mapping
comprises:

~~second~~-intercepting the TCP/IP connection parameters from the requests to
send/receive data from/to the servers ~~provided by said first intercepting~~;
and

establishing Infiniband connections between the servers and a TCP-aware target
adapter.

25. (Previously Presented) The method as recited in claim 24, wherein said executing
comprises:

providing the TCP-aware target adapter with memory locations within the servers
for transmission/reception of the data;

from the TCP-aware target adapter, transmitting the remote direct memory access
operations to the servers; and

from the servers, providing remote direct memory access responses.

26. (Previously Presented) The method as recited in claim 23, further comprising:

generating TCP/IP transactions in a native network protocol to provide the data to
the clients.

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27. (Currently Amended) A method for offloading server TCP/IP processing in a client-server environment, comprising:
- bypassing a TCP/IP stack otherwise employed in a server by ~~intercepting send/receive commands provided to the TCP/IP stack and~~ utilizing remote direct memory access operations via an Infiniband fabric to directly access data from/to server memory, wherein the data is provided to/from a TCP-aware target adapter, the TCP-aware target adapter providing native network ports that connect to clients, wherein said utilizing comprises:
- associating TCP/IP connection parameters for a particular TCP/IP connection with a work queue number that corresponds to a work queue pair within the TCP-aware target adapter; and
- issuing remote direct memory access requests to the work queue pair; and
- via the TCP-aware target adapter, generating native network transactions to transfer the data to/from clients.
28. (Cancelled)
29. (Currently Amended) The method as recited ~~in claim 28~~ in claim 27, wherein said generating comprises:
- formulating TCP headers, IP headers, and native network headers for messages to/from the clients based upon the TCP/IP connection parameters provided by said associating.

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30. (Currently Amended) A TCP-aware target adapter, for accelerating TCP/IP connections between a plurality of clients and a plurality of servers, the plurality of servers being accessed via an Infiniband fabric, the plurality of clients being accessed via a TCP/IP network, the TCP-aware target adapter comprising:
- an accelerated connection processor, configured to bridge TCP/IP transactions between the plurality of clients and the plurality of servers, wherein said accelerated connection processor accelerates the TCP/IP connections by ~~intercepting send/receive commands provided to corresponding TCP/IP stacks within the plurality of servers and~~ prescribing remote direct memory access operations to retrieve/provide transaction data from/to the plurality of servers, and wherein said accelerated connection processor comprises:
- a connection correlator, configured to associate TCP/IP connection parameters which uniquely identify the TCP/IP connections with corresponding work queue numbers; and
- a target channel adapter, coupled to said accelerated connection processor, configured to support Infiniband operations with the plurality of servers, and configured to execute said remote direct memory access operations to retrieve/provide said transaction data, and configured to route said transaction data to/from the plurality of clients as embedded payloads within Infiniband packets;
- whereby the TCP/IP connections are accelerated by offloading TCP/IP processing otherwise performed by the plurality of servers to retrieve/provide said transaction data.
31. (Original) The TCP-aware target adapter as recited in claim 30, wherein said accelerated connection processor supports TCP/IP transactions with the plurality of clients by formatting and processing native transactions in accordance with a native network protocol corresponding to the plurality of clients.

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32. (Original) The TCP-aware target adapter as recited in claim 31, wherein said accelerated connection processor encapsulates outgoing TCP/IP transactions within Infiniband raw packets for transmission to the plurality of clients.
33. (Currently Amended) The TCP-aware target adapter as recited in claim 32, wherein each said each of a plurality of accelerated TCP/IP connections comprises:
- a plurality of said remote direct memory access operations between a particular server and said target channel adapter to retrieve/provide particular transaction data from/to said particular server; and
- corresponding native transactions between said accelerated connection processor and a particular client to provide/retrieve said particular transaction data to/from said particular client, wherein said corresponding native transactions are encapsulated within Infiniband raw packets.
34. (Cancelled)
35. (Currently Amended) The TCP-aware target adapter as recited ~~in claim 34~~ in claim 30, wherein said TCP/IP connection parameters comprise: source TCP port number, destination TCP port number, source IP address, and destination IP address.
36. (Original) The TCP-aware target adapter as recited in claim 35, wherein said target work queue number corresponds to a host work queue number within a specific server, said specific server being designated by said accelerated connection processor to support said each of a plurality of accelerated TCP/IP connections with a specific client.
37. (Original) The TCP-aware target adapter as recited in claim 33, wherein said connection correlator associates native connection parameters with a target work queue number for said each of a plurality of unaccelerated TCP/IP connections.

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38. (Original) The TCP-aware target adapter as recited in claim 37, wherein said native connection parameters comprise: source MAC address and destination MAC address.
39. (Original) The TCP-aware target adapter as recited in claim 38, wherein said target work queue number corresponds to a host work queue number within a specific server, said specific server being designated by said accelerated connection processor to support said each of a plurality of unaccelerated TCP/IP connections with a specific client.
40. (Currently Amended) An Infiniband-to-native protocol translation apparatus, for routing TCP/IP transactions between a plurality of clients and a plurality of Infiniband devices, the plurality of Infiniband devices being accessed via an Infiniband fabric, the plurality of clients being accessed via a TCP/IP network, the Infiniband-to-native protocol translation apparatus comprising:
an unaccelerated connection processor, configured to bridge the TCP/IP transactions between the plurality of clients and the plurality of Infiniband devices by ~~intercepting commands provided to corresponding TCP/IP stacks within the plurality of Infiniband devices, and~~ encapsulating/stripping the TCP transactions within/from Infiniband raw packets, said unaccelerated connection processor comprising:
an unaccelerated connection correlator, for mapping native addresses to/from Infiniband local identifiers and work queue numbers; and
a target channel adapter, coupled to said unaccelerated connection processor, configured to receive/transmit said Infiniband raw packets from/to the plurality of Infiniband devices.
41. (Original) The Infiniband-to-native protocol translation apparatus as recited in claim 40, wherein said native addresses comprise MAC addresses.
42. (Original) The Infiniband-to-native protocol translation apparatus as recited in claim 40, wherein said native addresses comprise IP addresses.

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43. (Original) The Infiniband-to-native protocol translation apparatus as recited in claim 40, wherein said Infiniband local identifiers comprise source local identifier, destination local identifier, and work queue number.
44. (Original) The Infiniband-to-native protocol translation apparatus as recited in claim 43, wherein said Infiniband local identifiers map said TCP/IP transactions between a particular client and a server connected to an Infiniband fabric.
45. (Original) The Infiniband-to-native protocol translation apparatus as recited in claim 43, wherein said Infiniband local identifiers map said TCP/IP transactions between a particular client and a TCP-aware target adapter connected to an Infiniband fabric.